Anesthetic Resource Limitations and Adaptations in Times of Shortage

Experiences from New York Presbyterian Hospital During COVID-19

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KEYWORDS

• COVID-19 • Pandemic staffing • ORICU • New York Presbyterian

KEY POINTS

- The COVID-19 pandemic surge in March 2020 strained the New York Presbyterian-Columbia system.
- The Department of Anesthesiology continued to manage emergency surgical cases and obstetrics while expanding airway management and novel intensive care unit coverage throughout the system.
- Resource limitations were material, physical, and staffing.

INTRODUCTION

The first confirmed case of coronavirus disease 2019 (COVID-19) in New York City (NYC) occurred in March 2020. Because the virus had been spreading undetected in the community, confirmed cases then grew exponentially. Over the next 2 months, the NYC metropolitan area became the worldwide epicenter. At its peak in April, COVID-19 was responsible for more than 500 deaths per day in NYC. As of October 2020, there have been 241,403 confirmed cases and 19,211 confirmed deaths from COVID-19[1] (https://www1.nyc.gov/site/doh/covid/covid-19-data.page).

As cases surged, New York-Presbyterian Hospital (NYP) oriented most of its clinical departments around care of COVID-19 patients. The hospital faced significant resource limitations that required rapid adaptation. The Department of Anesthesiology was immersed in this effort, and stewardship of resources impacted its operations of

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perioperative care, airway and cardiac arrest team, and intensive care unit (ICU) management. These resources related to materials (eg, medications, personal protective equipment [PPE], and ventilators), space, and personnel.

These efforts were complicated by significant ambiguity: at the time, optimal management and therapies were far from clear, and little was known about the true risks and vector of transmission between patients and health care workers (HCW). Resource management was a balancing act between the current situation, in which safety of patients and staff was paramount, and the forthcoming surge in NYC, which would be of unknown duration and intensity. Even if specific resource limitations could be addressed acutely, contingencies had to be made if the disease surge reached an even higher peak or lasted months to years.

In this article, the authors discuss their experiences at NYP-Columbia University Irving Medical Center (NYP-Columbia) as they addressed these resource limitations during the initial surge from March through May 2020.

GOALS

The department of anesthesiology is one of the larger departments at NYP-Columbia. It includes approximately 115 full-time attending anesthesiologists, and 19 of them are subspecialty trained in critical care medicine. Among trainees were approximately 100 residents and 9 critical care medicine fellows. Under usual conditions, the department staffs the postanesthesia care unit (PACU) and 47 surgical ICU beds using a closed care model. Because airway management and critical care are paramount in an epidemic with predominantly respiratory symptoms, the department aimed to allocate personnel with diverse skillsets to provide care as broadly as possible.

In the initial phases of the pandemic during March, this meant simply keeping up with the large influx of patients with COVID-19 adult respiratory distress syndrome (ARDS) requiring intubation and weeks-long ICU stays, in addition to providing the standard level of care to non–COVID-19 patients (eg, labor and delivery). As the capacity of ICU beds and ventilators threatened to reach its maximum, we spearheaded the conversion of operating room (OR) space into a temporary operating room intensive care unit (ORICU) and provided most of the medical staffing.

As the number of critically ill hospitalized patients began to plateau, our focus shifted from sheer capacity to quality improvement, with the aim of ensuring the same level of care in ORICU as in traditional ICUs.

Throughout this process, we recognized that safety of our staff was complementary to our goals of providing high-quality care. We believed that the best care delivery required that staff members be healthy, rested, and engaged. By prioritizing both the physical and the mental safety of our HCWs, our goal was to combat attrition and ensure a healthy workforce particularly during the initial phase when the duration and extent of the COVID-19 surge in NYC were unclear.

APPLICATION

Operating Rooms

On March 14, elective surgical procedures were canceled in New York State, and so the case load was limited to emergency surgery[2] (https://columbiasurgery.org/news/regarding-covid-19). At NYP-Columbia, we scaled down our anesthesia sites to a total of 6 ORs, with one dedicated to COVID-19–positive patients or patients under investigation (PUIs) who needed surgical procedures. With the limited case volume, 6 ORs were sufficient throughout the surge. Preoperative and postoperative care was given in the preoperative area to minimize patient transport through parts of the hospital with

COVID-19 patients. With the cancellation of elective procedures, surgical case volume was reduced greater than 90%, and many of our perioperative services, such as the acute pain service, were deployed elsewhere, mostly in the ORICU. Our major adaptations are summarized in **Table 1**, with further discussion in the later paragraphs.

PPE was stored in various central locations, and the disbursement was staffed by an HCW to ensure equitable distribution. NYP-Columbia had adequate N95 masks for all HCWs, but masks designed to be single use were reused multiple times by a single HCW. Single-use masks reused multiple times was achieved by wearing a surgical mask over the N95. Some HCWs used the N95 for up to 2 weeks. For all COVID-19 patients or PUIs, standard contact/droplet/airborne isolation precautions were strictly followed in the OR: surgical mask with N95 mask underneath, bouffant cap, fluid shield, and isolation gowns and gloves were worn by all HCWs in the rooms. For non–COVID-19 patients, these precautions were technically not required; however, almost all HCWs continued to at least wear N95 masks with fluid shields, particularly because testing was limited in the very beginning of the pandemic.

In addition to PPE and dedicated COVID-19/PUI ORs, the Department of Anesthesiology took several additional precautions. For all operative cases in the COVID-19–designated room, the anesthesia cart was covered with plastic drapes to minimize contact spread and then fully moved out into the sterile core. All anticipated medications and equipment that were likely to be used were kept in the room and stored on the anesthesia machine, to be discarded at the end of the case. Emergency medications (eg, epinephrine and atropine) were kept in a separate sealed plastic bag; the entire contents of this bag would be discarded at the end of the case if the bag were opened. This limited accessibility had the benefit of providing an additional layer of security by preventing potentially contaminated gloves from reaching into the cart routinely.

Contamination of the anesthesia machines with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was a major concern. At NYP-Columbia, we use King Systems anesthesia circuits, which have built-in bacterial/viral filters on both the

Table 1
Perioperative anesthetic considerations during the COVID-19 surge

Material	Environmental	Personnel
Personal protective equipment: consolidated to a single station under direct supervision 24/7 to minimize theft	COVID-19 designated OR	Most anesthesia personnel deployed in ICUs and airway teams
Reuse of N95 masks until soiled or damaged	Preoperative and postoperative units combined	
HMEF used on all cases regardless of COVID-19 status		
Supply carts removed from OR and covered with plastic drape		
All anticipated medications kept in the room and discarded between cases (including emergency medications)		

inspiratory and the expiratory limbs. However, the manufacturer could not guarantee efficacy in preventing viral contamination of the anesthesia machine at the time of the COVID-19 surge at NYP. Another potential point of contamination was the end-tidal CO_2 side-stream modules, which sample gas at the circuit's Y-piece. Similarly, the manufacturers of our machines (GE, Drager) were unable to guarantee prevention of viral contamination. Consequently, we used heat moisture exchangers with integrated filters (HMEF) connected to the endotracheal tube (ETT) on every patient during the initial phases of the COVID-19 surge (Fig. 1). This barrier increased airway resistance and added dead space (more relevant for ICU patients; additional discussion later in the ORICU section). By May, manufacturers confirmed through independent testing that the $EtCO_2$ module filters prevented SARS-CoV-2 transmission, and the HMEF was moved to the expiratory limb. Months later, King Systems confirmed the efficacy of their built-in filters, and currently, we do not use additional viral filters on our anesthesia circuits.

Aerosol-generating procedures were considered high risk for transmission of SARS-CoV-2, including intubation and extubation, which are common procedures for patients undergoing anesthesia (particularly in emergency surgery). Our intubation strategy is discussed in greater detail later in the airway section. Our extubation strategy included extubating over a face-tent connected to suction or using a Plexiglas box (see Airway section); although far from precise, it was thought that this low-risk additional step was worth attempting to reduce airborne spread of the virus.

Airway Management

At NYP-Columbia, the Department of Anesthesiology staffs an airway team that responds to all emergency intubations and cardiac arrests outside of the emergency room and ICUs, as well as difficult airways anywhere throughout the hospital. This team comprises 1 attending anesthesiologist and 2 resident physicians. Our major adaptations are summarized in **Tables 2** and **3**, with further discussion in the later paragraphs.

Before the COVID-19 surge in NYC, the number of airway activations varied from day to day, but typically remained in the single digits over a 24-hour period. At the

Fig. 1. HMEF use on anesthesia machines. Initially it was unclear if the filters on the CO_2 sampling line and inspiratory/expiratory limbs of the circuits would protect the machine from SARS-CoV-2 contamination. The use of HMEF with confirmed filtration of viral particles at the level of the ETT-circuit connection prevented contamination and is shown here. As manufacturers completed their individual testing, the protocol changed, as the HMEF was moved first to the expiratory limb and then removed entirely (when the CO_2 sampling filter and then circuit filters were confirmed to prevent contamination).

Table 2
Airway and cardiac arrest team considerations during the COVID-19 surge

Material	Environmental	Personnel
PPE backpack (containing contact/droplet/isolation PPE for 2 anesthesia providers)	"Procedure rooms": negative pressure rooms dedicated to intubation	Specific COVID-19 intubation protocol
Portable video laryngoscopes		Creation of a second airway response team to meet volume demands
Aerosol boxes, ultimately not used frequently		Cardiac arrest simulations with medicine, nursing, and respiratory therapy
		Donning and doffing education videos and simulations
		Limiting personnel in room
		PPE observer role created for cardiac arrest

height of the surge, 30 intubations per day were carried out by the Department of Anesthesiology. This increased volume required the creation of a second airway team, the "nonemergency intubation" team. Unlike the traditional airway team, which is activated to a location via pager and overhead announcement, this team was contacted in the same manner as a consult service and was used for patients who needed intubation but were deemed stable enough to wait for at least an hour (for example, a patient who was fatiguing from increased work of breathing but was not imminently desaturating). Close communication and coordination between the 2 airway teams allowed us to triage the urgency of intubations to ensure optimal patient care.

We adjusted our approach to intubation in several ways to minimize the risk of transmission to HCWs. Because the highest risk of aerosol generation was thought to be the actual intubation procedure, NYP-Columbia initially established multiple negative pressure rooms that were dedicated as "procedure rooms." When medically possible, patients who were not already in a negative-pressure room would be moved into these rooms for intubation and subsequently transferred to an ICU once they were intubated and on a closed circuit with a transport ventilator. We further minimized risk by only sending the smallest number of staff in the room during the procedure itself: after all the appropriate equipment was set up, only 2 or 3 HCWs were in the room for induction, intubation, and connection to the ventilator. Backup staff members donned PPE and were available immediately outside the door for additional support in the setting of difficult intubation or hemodynamic instability. We also aimed to minimize time from induction to intubation in order to reduce HCW exposure: our department's policy was that the most experienced clinician on the team would be first to perform laryngoscopy (typically this meant the attending physician). To minimize aerosol generation associated with mask ventilation, rapid sequence intubation was the default approach. We performed video laryngoscopy by default, with the rationale that video laryngoscopy increased the physical distance from the patient's oropharynx. The portability and ease of sanitation of handheld devices over video laryngoscopes with a separate screen proved advantageous as well. Once the ETT was placed, the HMEF was connected and the ETT cuff was inflated before any ventilation to

Table 3
Novel intensive care unit considerations

Material	Environmental	Personnel
Personal protective equipment: consolidated to a single station under direct supervision 24/7 to minimize theft	ICU workspace: computers, pharmacy-dispensing stations, code carts, airway equipment, standard ICU supplies in carts/shelving units, communication boards, central monitoring, point-of-care blood analysis system, personal protective equipment	Tiered staffing model
Ventilators: anesthesia machines used due to shortage, with occasional limitations requiring backup ICU ventilators available	Patient rooms: HEPA-negative air machines, vital signs monitors, ventilators, data jacks, power outlets, gas supply (o_2 and room air), and a large volume of IV pumps, storage, and equipment shelving units	Significant investment in education: direct teaching, in-servicing, layers of supervision (both MD and RN), daily briefings, infographics, protocols
Drug shortages	Line-of-sight limited in novel spaces; requiring additional precautions for audio and visual alarms/assessments	Identification of areas of staffing shortage and creation of separate teams to address these limitations in patient care (eg, anesthesia helping fill traditional respiratory therapy roles)
	Pharmacy supply chain	Protocolization of care in general, with close ICU provider oversight for specialized management

rapidly establish a closed circuit to minimize viral contamination. When feasible, ventilation was immediately established by directly connecting to the ventilator to minimize the number of circuit disconnects.

We designed a system of PPE backpacks that the anesthesia clinicians would take to airway emergencies and cardiac arrests (Fig. 2). The PPE backpacks contained N95 masks, surgical masks, eye protection, fluid-proof isolation gowns (in contrast to the standard gowns used at NYP for contact isolation, which is only fluid resistant), extralong gloves in various sizes to ensure full coverage at the forearms, bouffant caps (not routinely stocked in isolation carts pre–COVID-19), and extra video laryngoscope blade covers. The backpacks were plastic rather than fabric to facilitate cleaning. These backpacks were sanitized and restocked in between uses and stored in a locked room only accessible to department personnel.

We used plastic aerosol boxes with similar design as reported in the literature.[3] These transparent boxes offered another layer between the patient and HCW to contain droplets and possibly aerosols. We trialed this equipment first in our simulation center and then for direct patient care. In anecdotal experience, use of the aerosol boxes appeared to increase intubation time and hypoxemic events; thus, we

Fig. 2. PPE backpack. Each bag contained HEPA filter, N95 masks (small and regular size), face shields, video laryngoscope blade covers, isolation gowns (waterproof), sterile gown, bouffant hats, beard cover, sterile gloves, and biohazard bag (for used video laryngoscope).

ultimately thought that the harms outweighed the potential benefits for routine use during intubation. The efficacy of this style of aerosol box in reducing HCW exposure has since been called into question.[4] We continued to use the device for extubation, which is less technically complex and therefore has fewer downsides.

Cardiac arrest management required specific considerations. Prepandemic, cardiac arrest activations at our institution often resulted in more than a dozen HCWs crowding into a patient room, often neglecting isolation precautions. Given the increased concerns for minimizing HCW exposure as well as conserving PPE, we created a new role of "Observer/Relay Provider." This role, typically filled by the charge nurse or patient care director, was primarily dedicated to standing by the door to personally confirm adequate donning and doffing procedures, to limit the number of HCWs to the bare minimum necessary for safe patient care, and to act as the point person for communication/equipment transport in and out of the rooms. After these protocols were formalized, we designed a cardiac arrest simulation and then hosted multidisciplinary sessions to reinforce education with internal medicine, nursing, and rapid response teams. Videos were recorded and distributed for further education.

OBSTETRIC ANESTHESIA

The Obstetric Anesthesiology Division at NYP-Columbia faced a different set of challenges but followed the same general principles of ensuring safe patient care while minimizing HCW exposure to SARS-CoV-2. The patient volume was unchanged because of the nature of the obstetric population. Aerosol generation during intubation/extubation was considered the highest risk; therefore, early neuraxial labor analgesia was strongly encouraged for all parturients. If necessary and unavoidable, general anesthesia and intubation were performed as described above in the airway management section. Even in March when the availability of polymerase chain reaction testing was still limited, the obstetric population was deemed high priority in the NYP system given the high risk for HCW exposure during emergency aerosol-generating procedures. Consequently, preadmission testing was performed on all labor and delivery patients, and this information was invaluable in ensuring proper isolation precautions were maintained. More in-depth discussion about the NYP-Columbia Obstetric Anesthesiology Division's response has been written elsewhere.[5]

OPERATING ROOM INTENSIVE CARE UNIT

At NYP-Columbia, the baseline ICU capacity is 117 beds across 8 discrete units. During the COVID-19 surge, we had a peak of more than 220 ICU patients. To meet the rapidly growing demand for ICU beds and ventilators, we created several novel ICUs over the course of weeks. The Department of Anesthesiology was primarily involved in the conversion of 23 unused ORs into an ORICU. The plan for an ORICU had strategic advantages: ventilators were running low quickly and the anesthesia machines were unused given the lack of elective surgery. In addition, given the anesthesia machines' large size, it seemed logical to convert the relatively large OR rooms into multiple bed ICU rooms.

Planning for ORICU began on March 21, when it became clear that the patient burden would rapidly overwhelm the standard ICU capacity, and within 2 days, the ORICU began accepting its first patients. The original plan was to admit low-acuity intubated patients from traditional ICUs. Specifically, patients requiring renal replacement therapy or experiencing severe hemodynamic instability were thought to be better suited for a traditional ICU. This approach lasted for less than a week before the large volume of ICU admissions required accepting patients to whichever bed was open, regardless of unit. The ORICU was active from March 24 through May 14 and cared for 133 patients in total.

The ORICU comprised 7 pods. A pod was a cluster of 3 or 4 ORs linked to a single sterile core. Most pods could treat 12 patients except for Pod G, which was a single room with a capacity of 6 patients (**Fig. 3**). Each sterile core conceptualized a self-sufficient ICU space with all necessary equipment: computers, pharmacy dispensing stations, code carts, airway equipment, standard ICU supplies in carts/shelving units, communication boards, central monitoring, point-of-care blood analysis system, and PPE. Additional equipment was stored in unused OR stockrooms as well as the PACU. These cores were also the primary points of entry/exit to the ORs to minimize foot traffic; the standard OR doors were only used for patient transport and otherwise kept locked. Although the ORs themselves were meticulously maintained with contact/droplet/airborne precautions, HCWs doffed their isolation gowns and gloves as they exited an OR but maintained droplet/airborne precautions in the core.

Each OR in the ORICU was converted to treat 3 to 4 patients, typically limited by physical space or gas access (**Fig. 4**). The first step in the conversion was the addition of HEPA negative air machines that converted the rooms from positive pressure to negative. After that, structural changes included additional vital signs monitors, ventilators, data jacks, power outlets, gas supply (both O_2 and room air), and a large volume of intravenous (IV) pumps (typically 6 per patient, given the need for prolonged sedation, vasoactive medications, and antibiotics). The layout of each room led to

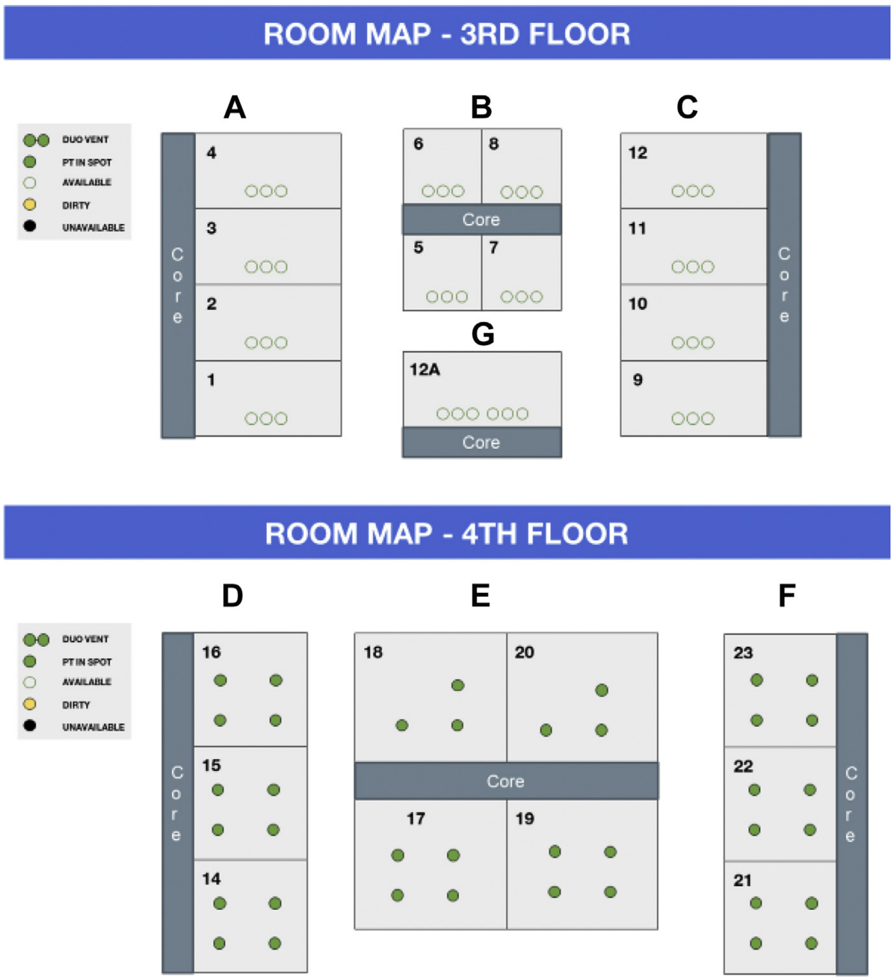

Fig. 3. Floor map of the ORICU. Each of 7 sterile cores was repurposed into an ICU workspace and connected to 3 to 4 ORs, each hosting 3 to 4 ventilated patients.

restricted visibility: unlike a standard ICU, which is designed to maintain line of sight, the ORICU only had 2 small windows into each OR from the sterile cores. Consequently, the rooms had to be arranged so vital signs, ventilators, and patients were facing these windows. Even still, these structural barriers provided a significant challenge as the numbers and alerts were often too small to be readily seen from the core. As an additional challenge, the heavy doors in the OR and the loud fans used for negative pressure made hearing alarms difficult. These visibility and structural issues were partially ameliorated by configuring the ventilator alarms to transmit to the central monitor station and installing cameras (intended for monitoring infants in the home) in the rooms. Despite these modifications, audiovisual problems persisted up until the closing of the ORICU.

At the time of the COVID-19 surge, ventilators were in short supply. Consequently, anesthesia machines (Drager, Datex-Ohmeda, and GE machines are in use at NYP-Columbia) were used as ICU ventilators for most patients in the ORICU. This was

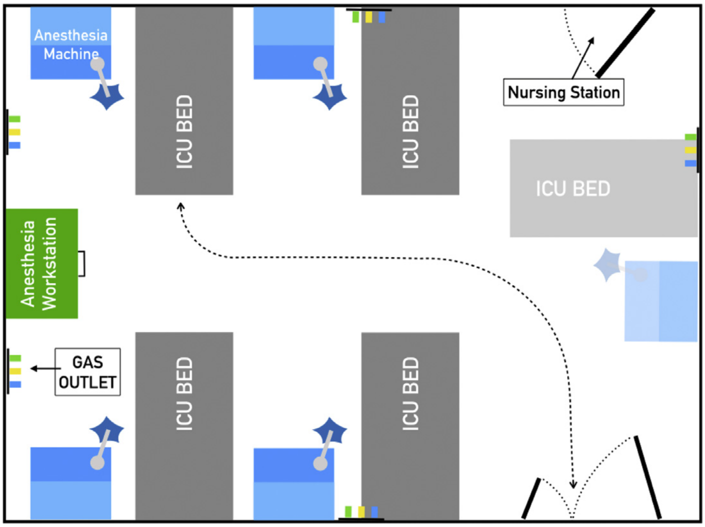

Fig. 4. Representative layout of a single ORICU room. This is one of the larger ORs and was able to hold 4 ventilated ICU patients. We followed 2 guiding principles for the room layout: 1. The beds and anesthesia machines had to be positioned close to a wall or beam-mounted gas outlets and data jacks (one per patient); 2. The patient had to be accessible from both sides of the bed; 3. The arrangement had to allow for each patient to be moved out of the room without other beds or equipment needing rearrangement, as most patients were severely ill. Each room had 1 anesthesia workstation containing emergency equipment and medicines for resuscitation. The light-colored bed and anesthesia machine on the right represent the possibility to extend capacity to 5 beds in case of increasing demand.

associated with several problems. First, the anesthesia machine maximum alarm volume was quieter than a standard ICU ventilator, as alluded to above. Second, the different handling and interface made the management more challenging; nursing and respiratory therapy were not familiar with the machines, requiring more direct anesthesia provider supervision during routine care (eg, increasing FiO_2 before turning a patient). Third, the anesthesia machines do not have built-in inspiratory and expiratory hold maneuvers to easily assess plateau pressures and intrinsic PEEP. Fourth, CO_2 absorbers were quickly saturated and needed frequent exchange. High gas flow rates were used (>15 L per minute) to minimize absorbent consumption as well as reduce moisture buildup in the HMEF, which increased resistance when fully saturated; this created the additional concern that we would exceed the hospital's central oxygen supply, which was addressed with biomedical and facilities departments. Finally, the anesthesia machines were unable to maintain adequate ventilation at the extremes of care: for the sickest patients with the worst compliance and highest respiratory rate, often the anesthesia machine would fail to deliver set volumes and the patient would need to be switched to an ICU ventilator (Puritan Bennett 840, LTV-1200, or Maquet Servo-U are all in use at NYP-Columbia). Consequently, 2 ICU ventilators were kept on standby in the event of inadequate ventilation, although the anesthesia machines were adequate for most patients.

The pharmacy division faced many challenges as well. From a logistical standpoint, doubling the ICU capacity meant supply chain issues, as these new ICUs all had to be restocked aggressively; this was especially true in late March and early April, when the vast majority of patients were deeply sedated for ventilation purposes. Furthermore, this high demand led to medication shortages. These shortages were addressed by our pharmacy team through twice-daily communications with ORICU leadership. For example, midazolam was briefly on shortage, so patients were switched to lorazepam, diazepam, or even chlordiazepoxide until the division could replenish their supply. Similar rotations occurred with fentanyl and hydromorphone. Overall, close communication allowed for adjustment of sedation agents with enough advance notice to educate clinicians on how to use less familiar medications, ensuring safe patient care in the face of significant resource limitation.

The staffing model required continuous iterative evaluation. Our model was based on the SCCM tiered staffing strategy[6] (https://www.sccm.org/Blog/March-2020/United-States-Resource-Availability-for-COVID-19), but needed adjustment for the staffing limitations experienced at NYP-Columbia (**Fig. 5**). First, there was a significant shortage of critical care nurses (CCRNs) and respiratory therapists (RTs). Many tasks were explicitly shared between nurses and medical clinicians, such as administering medications to help assist the non–ICU-trained nurses as they were thrust into an ICU nursing role. The available CCRNs were further prioritized for a “resource” role, which was more supervisory and focused on providing nursing assistance where needed. This model of shared responsibilities and increased supervision allowed for the flexibility needed to fill gaps experience and coverage. The Medical ICU nursing team established a portable prone team that could prone patients in any ICU (before the pandemic, prone positioning for ARDS could only be used in the Medical ICU). Formal nursing education efforts also occurred throughout the duration of the surge

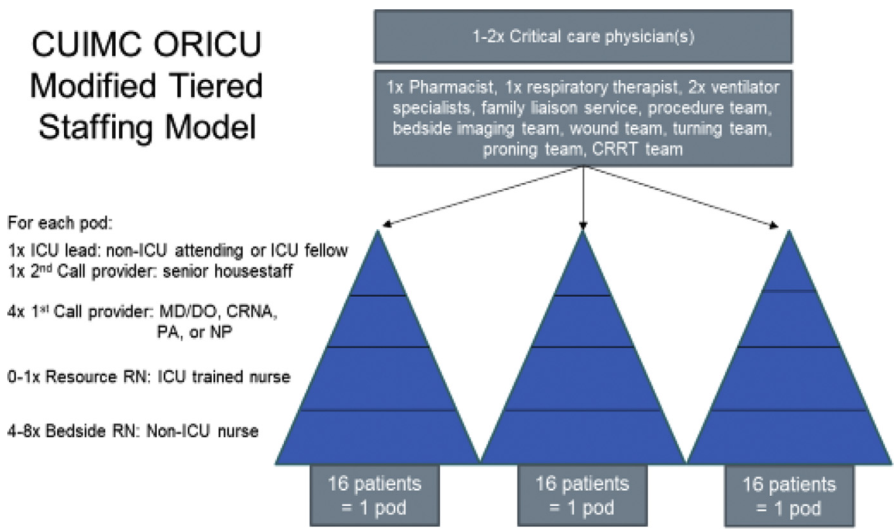

Fig. 5. CUIMC ORICU modified tiered staffing model. Based on the SCCM tiered staffing mode, adapted to meet our specific staffing needs. One to 2 critical care physicians provided oversight to 3 pods. Each pod of 16 patients was staffed by 1 “ICU lead” filling the traditional ICU attending role, 1 “second call provider” filling the senior resident/fellow role, 4 “first call providers” filling the APP/resident role, and a variable number of nurses depending on staffing availability. The largest modification to the SCCM model is seen in the large gray box in the middle: the many limitations (resource, skill, time, or knowledge) experienced during the COVID-19 surge necessitated the creation of many specialized ancillary teams to fill particularly challenging aspects of ICU care. CRNA, certified registered nurse anesthetist; NP, nurse practitioner; PA, physician assistant.

with dramatic effects. For example, dedicated wound care and turn teams focused primarily on teaching the non–ICU-trained nurses in addition to direct patient care, which ultimately had the effect of rapidly increasing competence of the ORICU nursing team.

Similarly, NYP-Columbia experienced a shortage of RTs during the surge. This, coupled with unfamiliarity with the anesthesia machines, necessitated the creation of the "anesthesia ventilator specialist" role. This role was filled by residents and attendings. The ventilator specialist team rounded on all ORICU patients at least twice a day and responded to any ventilator issues throughout the shift. Responsibilities included maintenance of the anesthesia machine (including assessing the need to exchange HMEFs and CO_2 absorbers), adjusting ventilator settings following the ARDSnet protocol, checking plateau and intrinsic PEEP, documentation, and performing typical respiratory interventions, such as delivering nebulized medications and performing endotracheal suctioning/lavage. Although a necessary step in minimizing contamination, the use of HMEF on all patients in the ORICU was particularly challenging for this team. When dry, the HMEF added minimally to airway resistance. However, when they became fully saturated, peak airway pressures were significantly increased by as much as 10 to 15 cm H_2O, often resulting in ventilation failure. Exchanging HMEFs became one of the first steps in troubleshooting high airway pressure alarms. Checking plateau pressures and intrinsic PEEP required specific education and protocolization because our anesthesia machines lack inspiratory and expiratory hold maneuvers. By investing effort into devising education and protocols with RT input, our anesthesia team quickly became facile with routine respiratory therapy tasks, which freed up the RTs to focus on more acute or complex management.

Because NYP-Columbia has a large roster of physicians and because elective procedures and outpatient clinics were on hold, the ORICU had access to many skilled clinicians. Most of the anesthesia and surgical residents worked as first- and second-call providers. Anesthesiologists in our department who were immunocompromised or elderly formed a Family Liaison Service that served as the primary point of contact with the family as well as facilitated goals of care conversations, freeing up the primary ICU clinicians to focus on clinical care. The Family Liaison Service was able to secure iPads through donations and scheduled video calls with patient families, allowing them to see their loved ones despite the limited visitation throughout the surge. The psychological impact of complete isolation of the patients from any family member was unprecedented and substantial; therefore, the Family Liaison Service proved to be essential in limiting the emotional stress and despair. Dermatologists joined the wound care team. Radiologists formed a point-of-care ultrasound team that was invaluable as echocardiology and radiology technicians were also understaffed to meet the surge in demand. Surgeons and interventional radiologists formed a bedside procedure service for arterial line, central line, and chest tube placement.[7] These services required significant communication and troubleshooting but paid off quickly, as the benefits to patient care were tangible and obvious.

The educational aspect was particularly important with the pandemic staffing model, where ICU attending physicians provided oversight to several non-ICU attending physicians and therefore could not round on every patient. This process was made easier by the relatively homogenous patient population, that is, everyone had the same primary disease process, which allowed us to protocolize key aspects of our management, particularly regarding sedation and ventilator support. Once these protocols were established, we adopted a multimedia approach to disseminating this information. Brief teaching sessions were held before rounds daily; infographics with key take-home points were hung in the cores, and printouts, such as rounding templates and protocols, were distributed to the staff (Fig. 6). Throughout the course of the ORICU, more than 100 guidelines, protocols, and infographics were generated. Through continued emphasis on education and quality improvement, the anesthesia department was able to ensure a high standard of care was delivered despite considerable variability in provider ICU experience.

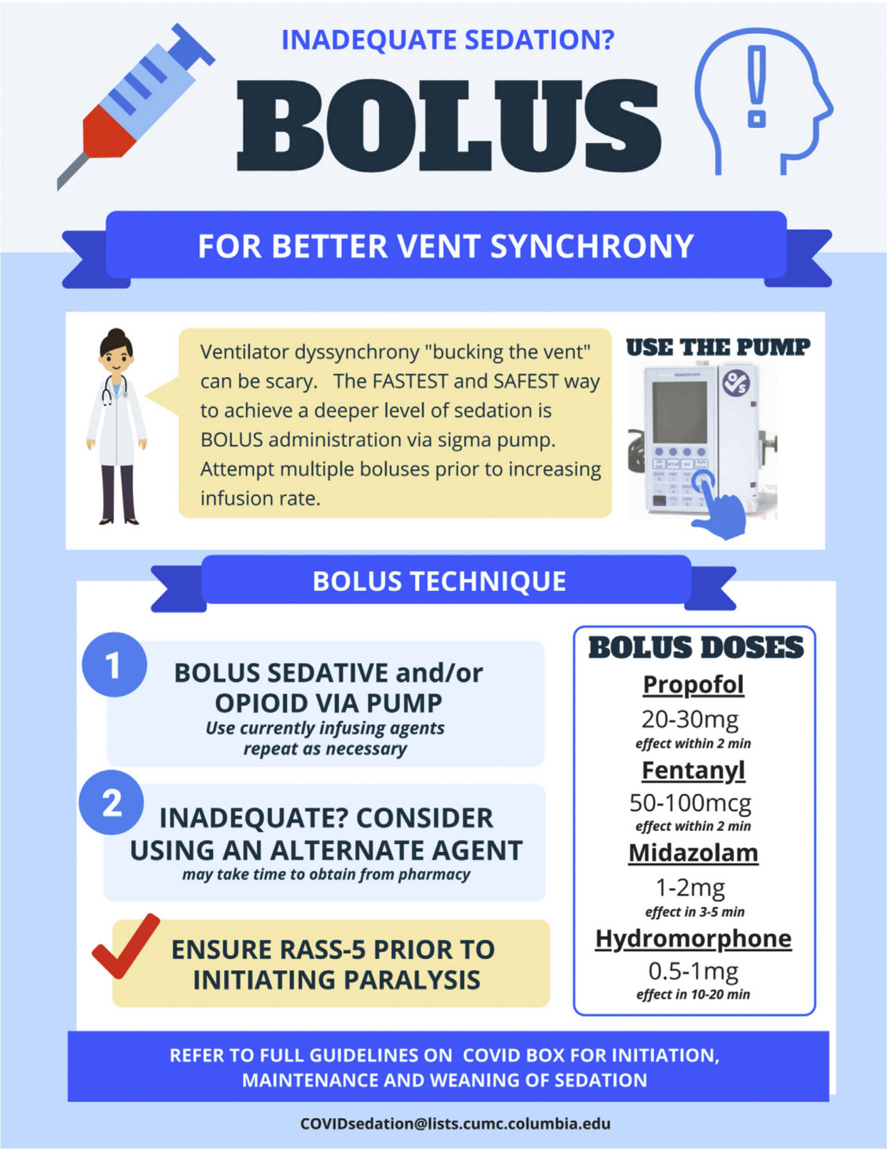

Fig. 6. Example infographic used for patient care education. With the redeployment of hundreds of non-ICU and nonanesthesia providers into ICU roles, rapid education was a priority. Sedation was particularly challenging in the ORICU patients given the additional physical barriers to both detecting and treating inadequate sedation.

DISCUSSION

The anesthesiologists at NYP played a key role during the COVID-19 pandemic, as the disease spread like wildfire throughout NYC during March 2020, quickly overwhelming health care systems. Throughout this, perioperative services were maintained and adapted to a novel disease with limited testing and unknown management; the airway and cardiac arrest teams were stretched beyond their usual capacity, and novel ICU spaces were rapidly established to accommodate the influx of critically ill patients. We faced material limitations, environmental obstacles, and personnel shortages; creativity, collaboration, and hard work were the only constants. By fostering an environment with continuous communication and feedback, we were able to identify and address most of the issues that arose. However, many of these solutions were merely stopgap measures.

Our experience highlights the need for a thoughtful pandemic preparation plan at all health care institutions. ICU nursing and RT shortages were managed by supplementing with a multidisciplinary team fully dedicated to the mission; however, “training up” non-ICU providers as well as recruiting experienced personnel is a lengthy process that could have started months earlier. Similarly, many of the environmental obstacles, such as the audio/visual barriers to alarms in novel ICU spaces, are clearly better addressed *before* these spaces are filled with contagious patients. As such, the authors hope that their experiences at NYP during the COVID-19 pandemic serve not only as a reference for addressing resource limitations but also as a reminder of the value of preparation.

SUMMARY

In a pandemic, particularly one with predominant respiratory disease patterns, such as COVID-19, anesthesiology departments play a critical role in delivering necessary airway management and ventilation support. Because elective procedures can be stopped, personnel availability may be increased during a crisis. Owing to the nature of a hospital-based specialty at the “crossroads” of medical and surgical care, anesthesiology departments are well positioned to be central players in a hospital response to a crisis.

DISCLOSURE

The authors have nothing to disclose.

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